

We claim:

1 1. A method of improving x-ray lithography in the sub
2 100nm range to create high quality semiconductor devices, for use
3 in the manufacturing of commercial and military semiconductor
4 devices used in phased array radar, missile seeking devices,
5 direct broadcast satellite television receivers, wide band
6 wireless systems, global positioning satellite receivers and
7 cellular telephones, and other equipment said method comprising
8 the steps of:
9 providing for the use and development of horizontal
10 beams from a synchrotron or point source of x-ray beams;
11 preparing of submicrometer, transverse horizontal and
12 vertical stepper stages and frames;
13 providing a stepper base frame for the proper housing
14 and mating of the x-ray beam;
15 minimizing the effects of temperature and airflow
16 control by means of an environmental chamber;
17 transporting, handling and prealigning wafers and
18 other similar items for tight process control;
19 improving the control and sensing of positional
20 accuracy through the use of differential variable reluctance
21 transducers;
22 controlling the continuous gap and all six degrees of
23 freedom of the wafer being treated with a multiple variable stage
24 control;
25 incorporating alignment systems using unambiguous
26 targets to provide data to align one level to the next;
27 using beam transport, shaping or shaping devices to
28 include x-ray point sources;

29 using an inline collimator or concentrator for
 30 collimating or concentrating the x-ray beams; and
 31 imaging the mask pattern at the precise moment for
 32 optimum effectiveness.

1 2. A method of improving x-ray lithography in the sub
 2 100nm range to create high quality semiconductor devices,
 3 according to claim 1, wherein:
 4 said using and developing of horizontal beams from a
 5 synchrotron or point source of x-ray beams step comprises the use
 6 of a beamline in parallel with the z axis.

1 3. A method of improving x-ray lithography in the sub
 2 100nm range to create high quality semiconductor devices,
 3 according to claim 1, wherein:
 4 said preparing of submicrometer, transverse
 5 horizontal and vertical stepper stages and frames step comprises
 6 providing a light weight, honeycomb structure;
 7 said preparing of submicrometer, transverse
 8 horizontal and vertical stepper stages and frames step further
 9 comprises providing a air or gaseous bearing;
 10 said preparing of submicrometer, transverse
 11 horizontal and vertical stepper stages and frames step further
 12 comprises providing vacuum clamping and mating surfaces;
 13 said preparing of submicrometer, transverse
 14 horizontal and vertical stepper stages and frames step further
 15 comprises providing active weight compensation;
 16 said preparing of submicrometer, transverse
 17 horizontal and vertical stepper stages and frames step further
 18 comprises linear actuators; and
 19 said preparing of submicrometer, transverse
 20 horizontal and vertical stepper stages and frames step further

21 comprises a fine alignment flexure stage of transverse horizontal
22 and vertical nanometer stages.

1 4. A method of improving x-ray lithography in the sub
2 100nm range to create high quality semiconductor devices,
3 according to claim 3, wherein:
4 said providing a light weight, honeycomb structure
5 step comprises the use of at least one composite material.

1 5. A method of improving x-ray lithography in the sub
2 100nm range to create high quality semiconductor devices,
3 according to claim 1, wherein:
4 said providing a stepper base frame for the proper
5 housing and mating of the x-ray beam step comprises providing
6 beam alignment and vibration insulation techniques when
7 connecting the stationary x-ray synchrotron or point source.

1 6. A method of improving x-ray lithography in the sub
2 100nm range to create high quality semiconductor devices,
3 according to claim 1, wherein:
4 said minimizing the effects of temperature and
5 airflow control by means of an environmental chamber step
6 comprises controlling the temperature and humidity; and
7 said minimizing the effects of temperature and
8 airflow control by means of an environmental chamber step further
9 comprises minimizing particle molecular contamination.

1 7. A method of improving x-ray lithography in the sub
2 100nm range to create high quality semiconductor devices,
3 according to claim 1, wherein:
4 said transporting handling and prealigning wafers
5 and other similar items for tight process control step comprises
6 using a cluster like environment in the coating, pre-baking,
7 aligning and exposing, post baking and quality control processes.

0987643.060701

1 8. A method of improving x-ray lithography in the sub
2 100nm range to create high quality semiconductor devices,
3 according to claim 1, wherein:

4 said improving the control and sensing of positional
5 accuracy through the use of differential variable reluctance
6 transducers step comprises providing positional feedback of the
7 six degrees of freedom alignment stage.

1 9. A method of improving x-ray lithography in the sub
2 100nm range to create high quality semiconductor devices,
3 according to claim 1, wherein;

4 said controlling the continuous gap and all six
5 degrees of freedom of the wafer being treated with a multiple
6 variable stage control step comprises using a device having a
7 cross coupled gantry design.

1 10. A method of improving x-ray lithography in the sub
2 100nm range to create high quality semiconductor devices,
3 according to claim 1, wherein:

4 said incorporating alignment systems using
5 unambiguous targets to provide data to align one level to the
6 next level step comprises using multiple bright field optical
7 microscopes in order to provide x, y and z, magnification and
8 rotational data; and

9 said incorporating alignment systems using
10 unambiguous targets to provide data to align one level to the
11 next level step further comprises using an additional imaging
12 broad band interferometer alignment system for providing precise
13 alignment of wafer levels and gap controls during x-ray exposure
14 and imaging.

add a2
b5